N85-32436

TEMPERATURE-STRESS MODELING

WESTINGHOUSE ELECTRIC CORP.

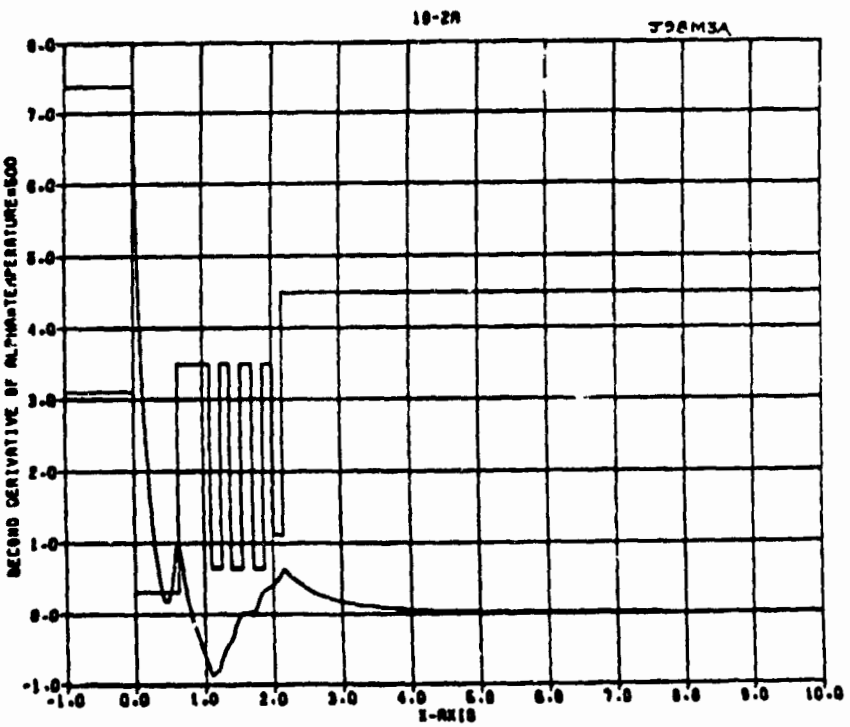
R. Seidensticker

Overall Goals

- Develop Higher Throughput Systems
- Clarify Limitations on Ultimate Throughput

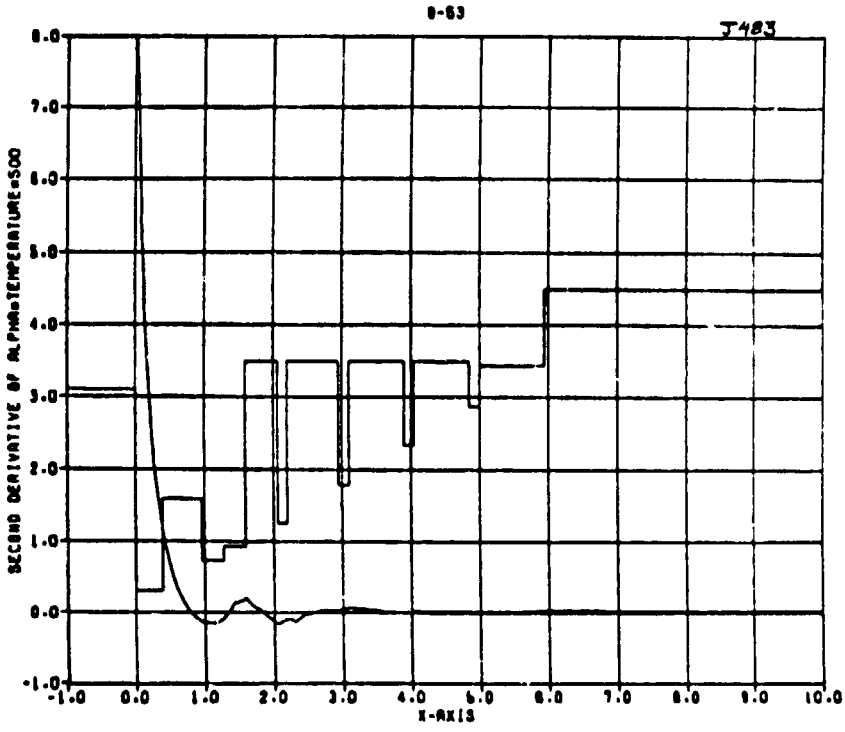
Current Work

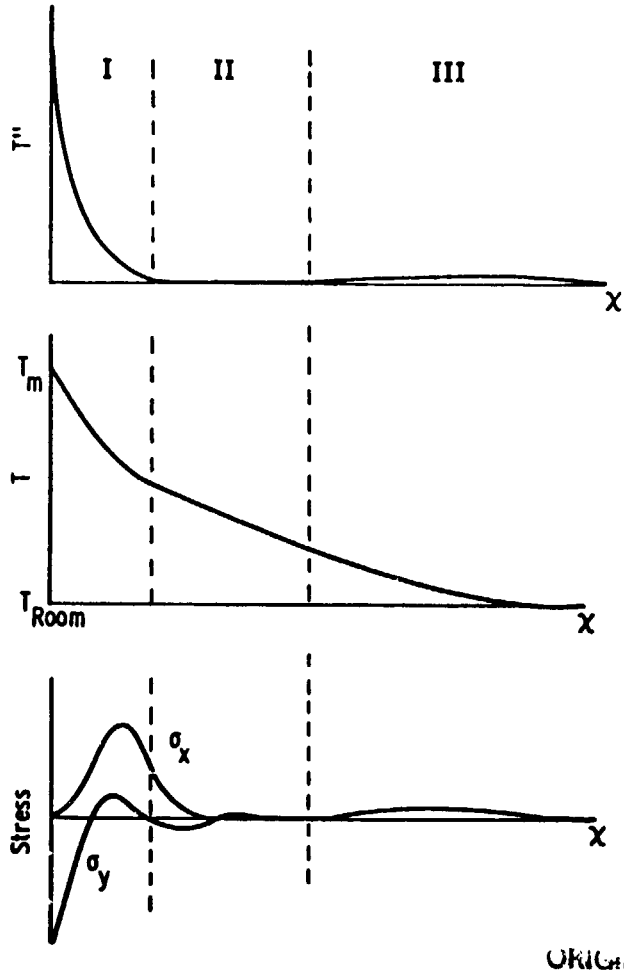
- Temperature/Stress Fields near Growth Front
- Effects of Lateral Temperature Gradients



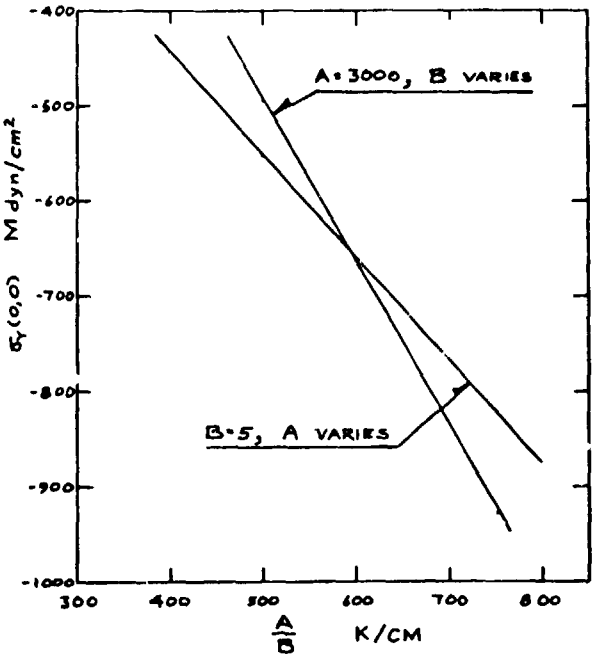
PRECEDING PAGE BLANK NOT FILMED

SILICON SHEET





Dependence of σ_y at Interface on A/B; w = 1.35 cm



Stress Fields at Growth Front

Model Representation

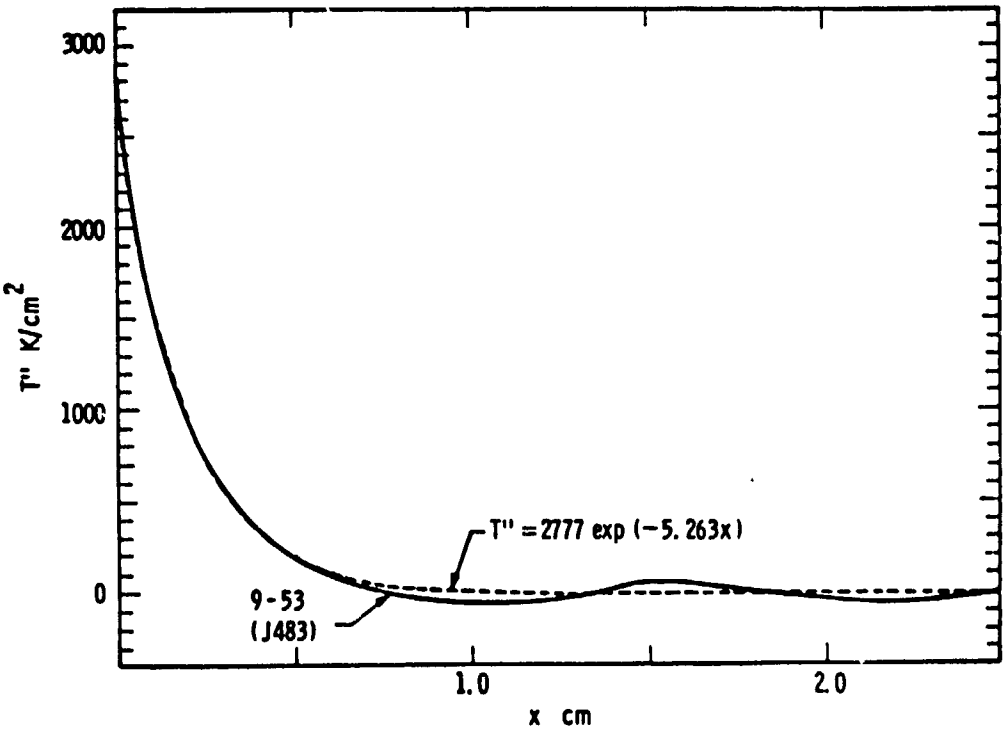
$$T(x) = \frac{A}{B^2}\exp(-Bx) + Cx + D$$

$$T''(x) = A\exp(-Bx)$$

$$T'(0) = -\frac{A}{B} + C$$

Results:

Stress fields depend on A and B but <u>not</u> on C and D



Lateral Temperature Variation

With Dr. R. F. Sekerka

Causes:

1. Variation in thermal environment across width of web
2. Variation in cross section across width of web

Modeling Representation

$$T(x,y) = T(x)\, g(y)$$

where

$$T(x) = \frac{A}{B^2} \exp(-Bx) + Cx + D$$

and

$$g(y) = \frac{1 + c_n (y/w)^n}{1 + c_n/(n+1)}$$

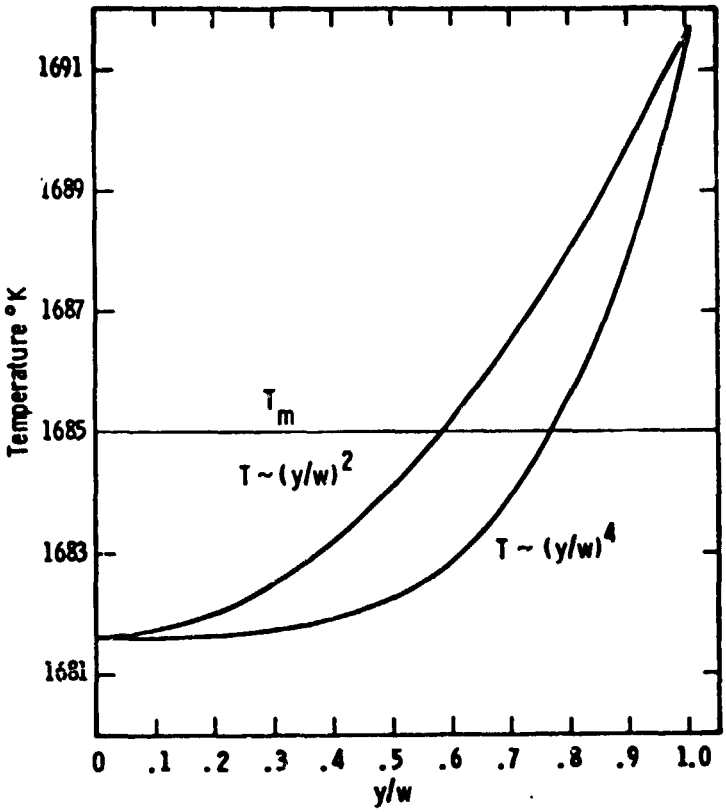
where w = ribbon half width

$c_n > 0$ concave upward (smiling)

$c_n < 0$ concave downward (frowning)

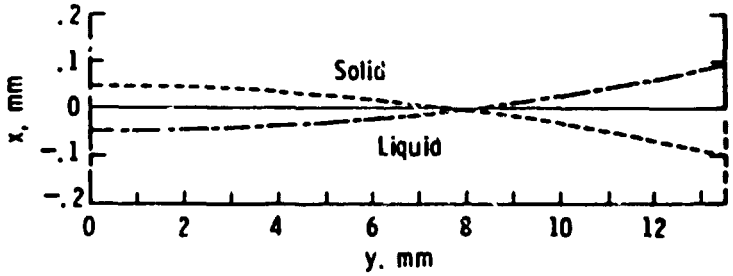
$n = 2$ quadratic case

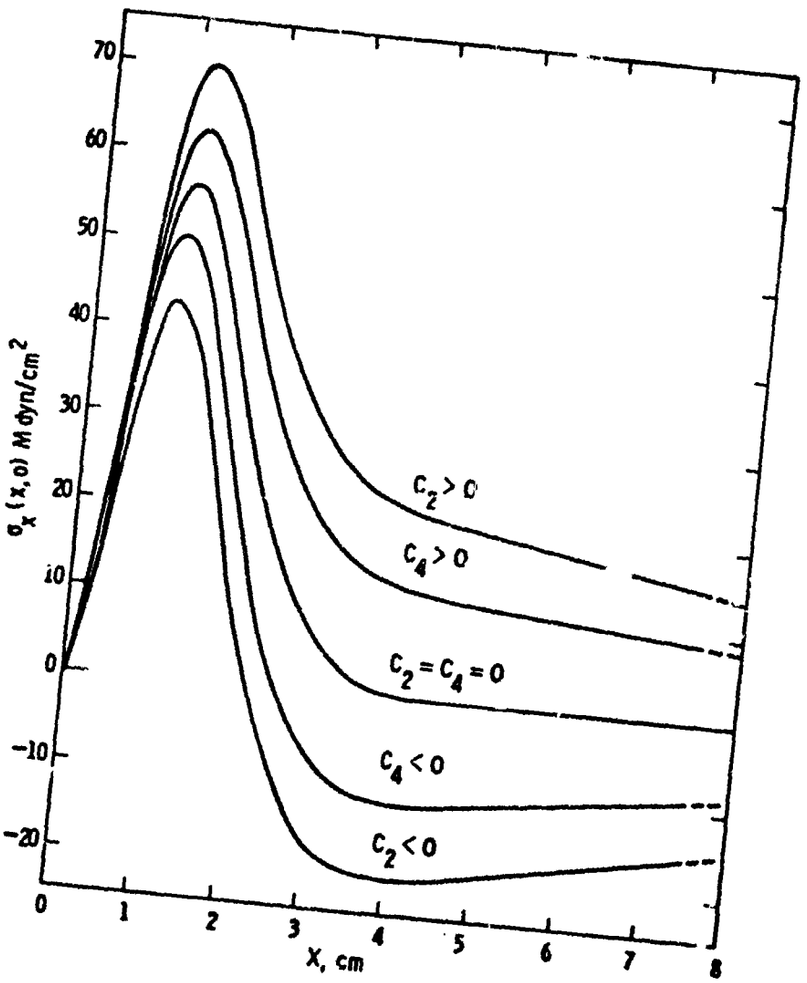
$n = 4$ quartic case

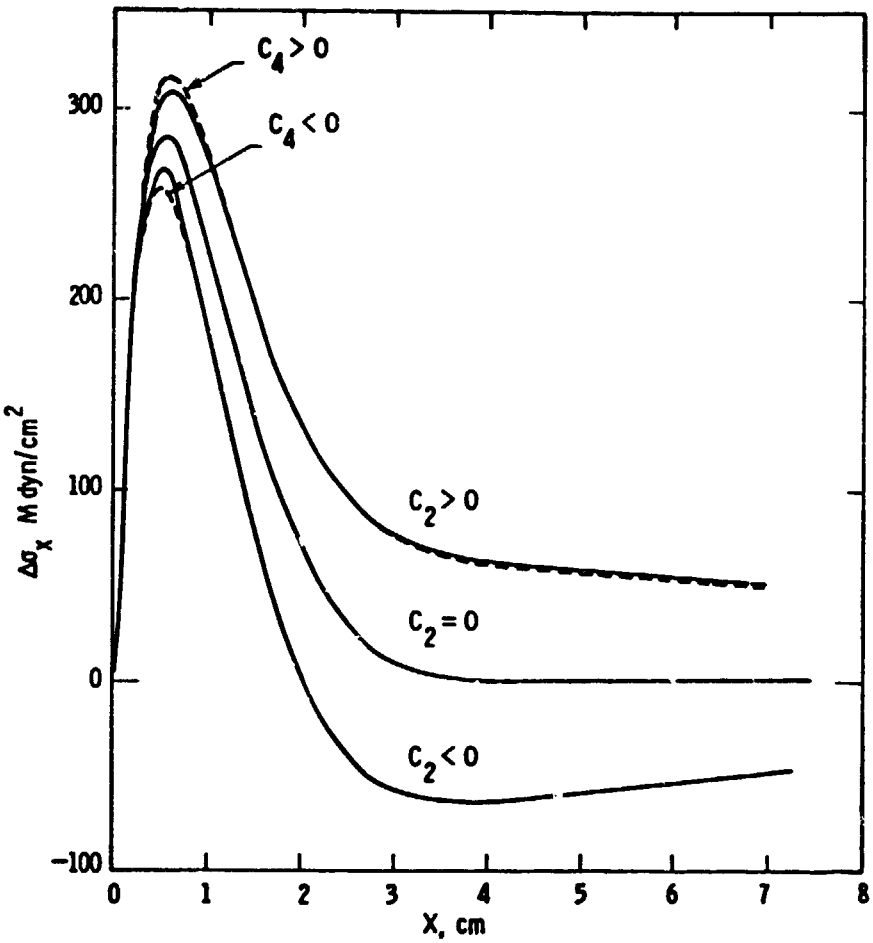


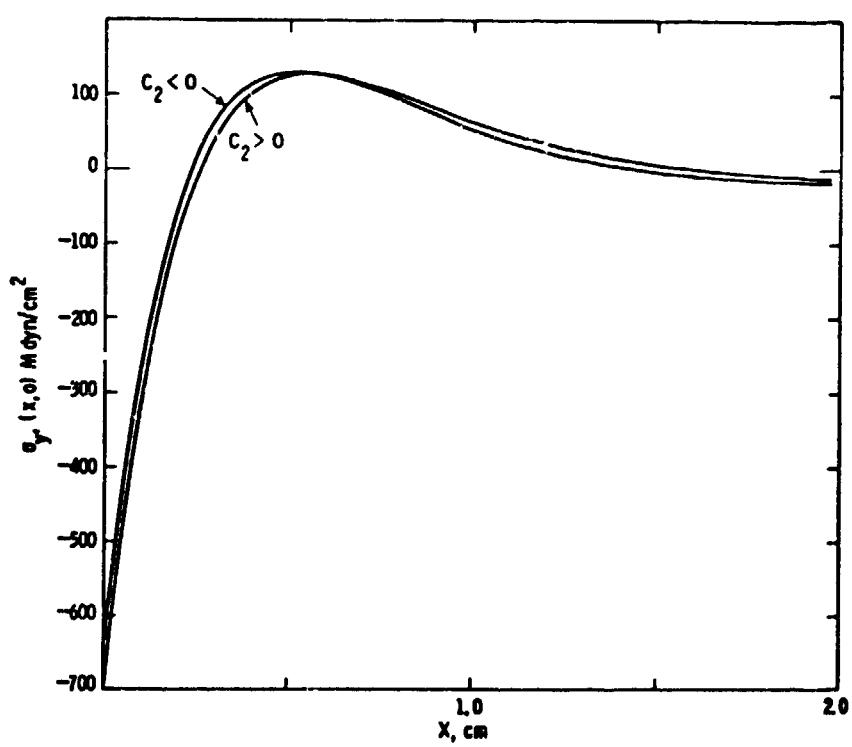
Temperature Profile at X = 0

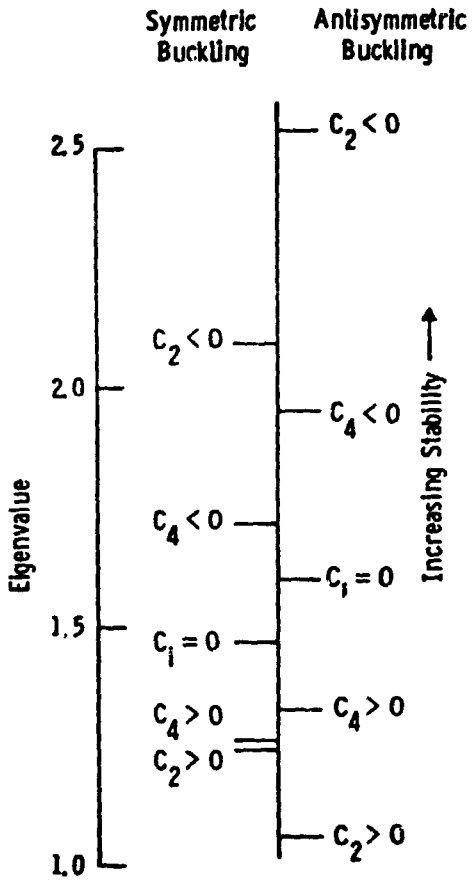
Interface Shape for Curved Isotherms




70
60
50
40
30
20
10
0
−10
−20
$\sigma_x(x,o)$ M dyn/cm^2
$C_2 > 0$
$C_4 > 0$
$C_2 = C_4 = 0$
$C_4 < 0$
$C_2 < 0$
0
1
2
3
4
5
6
7
8
X, cm







Lateral Temperature Variation: Summary

"Frowning" Isotherms:

- Inhibit buckling
- Should not affect residual stresses

The J460L configuration has been modified to produce more frowning" isotherms in the web